

elongation of the limb of the planet. Had it existed to the extent of one hundredth of the diameter of Venus, I am confident I should have seen it.

"At last external contact I fancied that the limb of the sun at point of contact was broken more rapidly than it should be, but if there was a 'bead' it was a very minute one.

"At first internal contact, in spite of the low altitude of the sun, the definition of the perimeters of both it and the planet was excellent; but at last internal contact, owing to the great heat and a strong land breeze, there was some amount of atmospheric interference.

"The time of the transit was taken with an ordinary watch, a good goer, and I hope to be able to fix the position of the station before long, although such observations here must of course be of very secondary consideration.

"During the transit I tried to obtain absorption bands from the atmosphere of the planet, but failed, owing to insufficient power and the difficulty of keeping the slit of the stellar spectroscope used, on the planet, with altazimuth motion.

"I may mention that on the evening of the 9th there was a fair display of parhelia, just at sunset. The sky was then covered with delicate bands of cirrocumulus."

ON THE AGE OF AMERICAN STONE IMPLEMENTS, OR "INDIAN RELICS"

THE interest connected with the various forms of ordinary stone implements, of which arrow-heads are by far the most abundant form, is greatly lessened by the fact that nothing connected with their discovery bears upon the question of the date of their origin. We know about the date of the introduction of iron, by European visitors to our country, and therefore about the time of the abandonment of stone implements and weapons by the Red men; but concerning the time of the commencement of the use of stone here in the States we are almost wholly in the dark.

Having, during the past three years, had unusually favourable opportunities for collecting the various types of relics from a locality extraordinarily rich in them, we have endeavoured to learn something concerning the date of their origin by studying them *en masse* and *in situ*, as in this manner they at least suggest probabilities, which isolated specimens, gathered from numerous and distant localities, would never do. During the past three years we have gathered and carefully examined, as they were taken from the soil, over nine thousand stone implements, embracing fully nineteen twentieths of the forms described by Mr. John Evans in his "Ancient Stone Implements of Great Britain," and some twenty forms of weapons and household implements not mentioned in his work.

The result of the examination of this enormous collection of specimens on the spot where they were found, has been to convince us that the ruder forms, usually of slaty rock and other minerals softer than flint, are older, as a rule, than the beautiful jasper specimens found immediately above them. No such conclusions could be arrived at from merely examining these same specimens in a cabinet, and if these ruder and more elaborate forms were intimately associated in the soil, it would be difficult to dissociate them; but taking the history of the discovery of each specimen separately, we find that just in proportion as these relics are rude in manufacture and primitive in type, they are more deeply embedded in the soil. We have never met with a jasper (flint) arrow-head in or below an undisturbed stratum of sand or gravel, and we have but seldom met with a rude implement of the general character of European drift implements on the surface of the ground; and when such specimens did occur, there were generally some indications of unusually deep disturbance of the surface of the ground. Indeed, it is in fact just what it should be in theory, *i.e.*, the older forms are found alone, and at considerable depths below the surface; the newer and latest types found only at the surface, except when in graves, and associated with these

a few specimens of the more archaic forms; just as we now in our own time see, in some isolated localities, household implements still in use, that, as a rule, have been discarded for better forms for more than a century. We repeat, that the conclusions arrived at by us we claim to be warranted by the fact of their applying to the collection of over nine thousand specimens gathered by us from a limited locality, and examined at the time of their discovery with special reference to the relationship the rude and elaborate forms bore to each other.

The belief here expressed with reference to the relationship of rude and elaborate relics is in accord with the division of the Stone Age into a Palcolithic and a Neolithic era; inasmuch as no indication of a *polish* has been found on any of the rude relics gathered by us; and polished celts and grooved axes with well-ground blades, or edges, occur only on the surface or in graves. It may be well to state here that by the phrase "on the surface" we mean on or in the soil that is now in cultivation. Relics that are upturned by the plough are considered as being "on the surface,"—beneath the surface being the stratum underlying the cultivated soil, and so beyond the reach of the ploughshare.

When and how the Atlantic coast of North America became peopled by the Red men cannot be determined by these same relics; but that that event should have been comparatively recent, and that such rude relics as we now find deeply embedded in the earth, and the magnificently wrought agate and jasper spears, and polished porphyry and hematic celts, should have been in use at the same time and by the same people, is simply incredible. We cannot now go into the full details of all the points of interest connected with our discoveries, but offer with confidence to students of American archaeology this fact, that the paleolithic relics are immensely older than the elaborately worked surface-found forms. This fact, we believe, is a powerful support to the theory (if, indeed, it needs further demonstration) of the gradual development of man from the condition we call savagery.

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NOTES

THE invitation addressed by the King of Siam to the Royal and the Astronomical Societies ought to be gratifying to scientific men in more ways than one; it is one more evidence of the spread of a respect for science, and of an idea, however vague, of its high value. The letters amount, indeed, as the *Times* remarks, to the offer of a large subsidy on the part of the King, and are no empty compliment. They indicate in the clearest manner the effect which the steady prosecution of inquiries by the most civilised is having in the less civilised countries; an effect of an important kind, which it would be difficult to arrive at in any other peaceful way. The following is the text of the King's letter to the Astronomical Society:—"The Royal Palace, Bangkok, Oct. 9, 1874.—My dear sir, I have much pleasure in informing you that I have received the commands of his Majesty to request you to inform the Royal Astronomical Society that if it will appoint men of science to observe the total eclipse of April next, his Majesty will be happy to consider them as his private guests during their visit, and will take on himself their entertainment and provide them with transport for themselves and their instruments from Bangkok to the station selected by them and back again, and will erect such temporary buildings as are required for them and their assistants. A communication to this effect will be made by his Excellency the Minister for Foreign Affairs to the Acting British Consul-General here; but as this will be slow in reaching the gentleman interested, his Majesty has commanded me to address this note to you to communicate it to the Society as soon as possible. I shall be most happy to

receive any communication from the Secretary of the Society named; and if any gentlemen propose to avail themselves of his Majesty's invitation, I should wish to receive particulars of the probable number of the party or parties, of the station or stations proposed, and the foundations required for instruments—a plan, in fact, for each intended observatory, that I may submit them for his Majesty's orders. You may state that our topographer, Capt. Loftus, and other officers who, as surveyors, are accustomed to precise observations, will be happy to assist if desired, and his Majesty will willingly release them from their other duties for this purpose. With the assurance of my high esteem, believe me, my dear sir, your most faithful friend, BHASHA-KARAWONGSE, H.S.M. Private Secretary."

THE great solar eclipse of 1868 was visible in Siam, as the 1875 eclipse will be. The then reigning Siamese king had not invited any European astronomer; but the French Government sent an expedition, who located themselves in Malacca for the purpose of taking spectroscopic observations. The King of Siam, who professed to be an astronomer, came with a royal train and a large army to observe the sun and perhaps the sun-observers. The observations were very successful indeed; but the French astronomers had located themselves on marshy land and were almost all attacked by fever, of which they were cured only on their return to France. Such was not the case, however, with their royal guest, who was also attacked, and died a few months afterwards.

A TELEGRAM, dated Hong Kong, January 9, states that the *Challenger* has left that place in continuation of her cruise.

WE are informed that a subscription list has been opened in Stockholm for the purpose of erecting a monument to Scheele, whose discoveries gave such a powerful impulse to the advancement of chemical science in the eighteenth century.

IT is also reported that there is a probability of a monument being erected in Brussels in honour of the late M. Adolphe Quetelet, the well-known Secretary of the Belgian Academy.

A NEW section of the Glasgow Philosophical Society—Section C, Physics (including Mechanics and Engineering)—has been formed, with Jas. R. Napier, F.R.S., as president, Prof. Sir Wm. Thomson, LL.D., F.R.S., and Prof. R. Grant, LL.D., F.R.S., as vice-presidents, and Thos. Muir, M.A., F.R.S.E., as secretary, and has already begun to do good work in the cause of original research. The success of this section, along with that of the recently organised Science Lectures Association, affords good evidence that in Glasgow, as elsewhere, there is a significant stirring among the dry bones from which we may hope for valuable results in the not distant future.

THE January number of Petermann's *Mittheilungen* contains a letter from Dr. Nachtigal, who has done for the eastern countries of the Sahara and Soudan what Barth did for the central, telling of his return to Cairo after an absence of about six years. He was received by the Viceroy and the German inhabitants of Cairo with the greatest honour. As his health has been considerably impaired by the hardships he has had to undergo, he intended to stay some time in the genial climate of Egypt to recruit, not caring to plunge suddenly into the rigours of a northern climate. Dr. Petermann gives a brief *résumé* of the course of Dr. Nachtigal's journeys.

THE scheme which was proposed about a year ago for the erection of an aquarium, to be built on the beach at Hastings, has been revived, and we are informed that a limited liability company, composed of local capitalists, has been started for the purpose of carrying out the project. The building will be erected a little to the east of the present pier, and one of the two designs to which premiums were awarded last year will probably be adopted.

FROM a previously undisturbed deposit on Funk Island, a guano-covered rock to the east of Newfoundland, several bones of the Great Auk (*Alca impennis*) have been recently brought to this country. They are not in a first-rate state of preservation, being considerably injured by exposure.

THE Marquis of Bute has recently purchased eight Canadian Beavers, seven of which have arrived safely in the Island of Bute, and have been placed in the enclosure constructed for the four which died some time ago on Drumreoch Moor. To increase the chance of their acclimatisation, the animals will be supplied with a certain amount of food for some time to come.

FROM a report of a journey into the interior of Formosa made in the latter part of the year 1873, we learn that the flat portion of the country is almost everywhere cultivated with the greatest care: the principal crops are rice, sugar-cane, and sweet potatoes; and the minor crops, pea-nuts (*Arachis hypogaea*), indigo, and *Areca palus*. The mountain region, though very steep and rugged, was covered with thick tropical forest. Tree-ferns, as well as other ferns, grew luxuriantly; and in places where there was a bit of level ground, Chinese had formed settlements around which they were growing rice, and were clearing patches of the hill-sides for the cultivation of tea. Formosa is the island from whence we obtain our supplies of the camphor of commerce, but in the interior the trees which abound in the forests are said to be left untouched, as the natives do not know how to make camphor.

THE cultivation of cocoa (*Theobroma cacao*) is being largely extended in Guayaquil. New plantations have been found, and new trees planted on the old estates, so that the average yield will be greatly increased. The crop of 1873 was the largest yield known for many years. Another of the chief products of Guayaquil is indiarubber, or caoutchouc, the yield of which has very much decreased of late, owing to the custom of destroying the trees to collect the gum, so that it has become necessary to go further into the forests in search of the trees, which, together with the increased difficulty of transport, has added much to its first cost.

ONE of the large Blue Gum Trees (*Eucalyptus globulus*) in the Temperate house at Kew is now showing bunches of fruit. These fruits are from three-quarters to an inch in diameter, and are peculiar on account of their hard woody nature, being nearly enclosed by the ligneous calyx, and opening at the apex by valves corresponding in number with the cells.

AMONGST economic plants of interest at present flowering at Kew, the Tea-plant and the Star Anise claim notice. A fine bunch of the Black Tea (*Thea chinensis*), var. *Bohea*, cannot fail to attract attention in the Temperate house at this season, where flowers in general are scarce. Though the genus *Thea* is so closely allied to that of *Camellia*, its flowers are comparatively inconspicuous when compared with those of the well-known *C. japonica*. The large yellow anthers, however, redeem it from insignificance. The Star Anise (*Illicium anisatum*), which find a home in the Economic house, is a native of South-west China, growing to a height of about fifteen feet. The common name of Star Anise is derived from the stellate form of the fruit when ripe, and its odour somewhat resembling that of aniseed. Large quantities of these fruits, with the seeds in them, are exported from China to Europe and India. On the Continent they are largely used to flavour spirits, but with us their chief use is for expressing an essential oil, which is frequently sold for real oil of aniseed.

THE differences between the organisation of the French Academy of Sciences and the Royal Society are striking. Any-one wishing to become a French Academician is obliged to visit each of the electors and to ask personally for their suffrages.

The number of French Academicians is strictly limited, and no new member is appointed except to fill a vacancy. There is a special section open to members who may have no sufficient scientific qualifications; they are called *Académiciens libres*, and belong to no special section, but cannot vote in the election of members, and are not paid.

EXPERIMENTS have been tried on some French railways for warming passenger cars by a stove, which is placed outside. It is said a single stove is sufficient for a whole car, and the expense is very small indeed, twenty-six pounds of coal keeping up the fire for about 200 miles. The warmed air circulates inside the car.

ATTENTION has been drawn in France by the news of the burning of the *Cospatrick* to the proper means for extinguishing fire on board ships. M. de Parville advocates in the *Débats* the obligatory use of signal-thermometers in the hold; each elevation of temperature being notified by the ringing of an electric bell. Others advocate the use of extinguishers. These are large bottles full of compressed carbonic acid, which may be of immense use in limited spaces, perhaps more valuable than water.

WE notice to-day the sailing of the *Timaru*, from Glasgow, with a consignment of salmon eggs for Otago, New Zealand. The ship *Tintern Abbey* has also recently sailed for New Zealand, having on board no less than 1,130 living birds, viz., black-birds (*Turdus merula*), thrushes (*Turdus musicus*), starlings (*Sturnus vulgaris*), redpoles (*Linota rufescens*), of each 100; hedge-sparrows (*Accentor modularis*), 150; linnets (*Linota cannabina*), 140; goldfinches (*Fringilla carduelis*), 160; yellow-hammers (*Emberiza citrinella*), 170; and, lastly, partridges (*Perdix cinerea*), 110. When the birds arrive in New Zealand they will be let fly under proper authority. There is, we understand, a heavy penalty enforced against shooting at or injuring these birds in New Zealand, and it is hoped that they will do well at the Antipodes. The New Zealand farmers cannot get on without them, for they keep down the insects that ravage the crops. The Acclimatisation Society of Canterbury, New Zealand, we understand, have begun and are now persevering in this good public work.

THE weather has been extraordinarily warm and genial in Paris, as in London, and in the whole of France, for some days, but almost all the rivers have been swollen to a dangerous height owing to the rapid melting of immense quantities of snow. Disasters have been experienced along the banks of many streams, principally the Rhone. At Lyons the disasters were increased by a stockade or *barrage* erected suddenly across the stream. All the ice collected and produced an immense iceberg at a point called Ile Barbe. It was feared for a while that this stupendous mass of ice would force its way above the stockade and destroy everything below, and great efforts were made unsuccessfully to get rid of it. But the continuance of the genial temperature has gradually destroyed the obstruction. Never was the theory of regelation, as propounded by Tyndall, submitted to the test of a larger experiment.

MESSRS. H. S. KING and Co. have in the press, and nearly ready for publication, the following works relating to science:—"Mankind: a Scientific Study of the Races and Distribution of Man," considered in their bodily variations, languages, occupations, and religions, by Dr. Peschel.—Translations of two new works by Prof. Ernst Hæckel: viz., "The History of Creation," edited by E. Ray Lankester, M.A. This book will be illustrated by coloured plates and genealogical trees of the various groups of both plants and animals.—"The History of the Evolution of Man," translated by E. A. Van Rhyn and L. Elsborg, M.D., with various notes and other additions sanctioned by Dr. Hæckel. Also the following new

volumes of their International Scientific Series:—"Fungi;" their nature, influences, uses, &c., by M. Cook, M.A., LL.D., edited by the Rev. M. J. Berkeley, M.A., F.L.S. "The Chemical Effects of Light and Photography in their application to Art, Science, and Industry," by Dr. Hermann Vogel, of Berlin; and a treatise on "Optics," by Prof. Lommel, of the University of Erlangen. These three books will be profusely illustrated.

MESSRS. SMITH, ELDER, and Co. will publish, in a few days, a work called "The Cremation of the Dead," by Mr. William Eassie, C.E., who is well known for his work in sanitary matters.

THE cultivation of oysters has been attempted by the United States Commission of Fisheries in the Great Salt Lake of Utah, where numbers of these bivalves from California have been placed with the view of testing the possibility of their thriving there. Some beds were choked by mud brought down some small streams, but in other parts the oysters promise to succeed. Shad have also been placed in the lake and have been seen in good health, and a lot of salmon fry from the Sacramento, artificially hatched out, have been placed in the Jordan and other rivers running into the Great Salt Lake. So far, in the fresh waters, they have done well, and at ten months old were from four to six inches long. It remains to be seen whether they will thrive as well in the salt waters of the lake as in the sea itself. The experiment is a most interesting one, and opens up some curious questions in the natural history of the salmon and the other fish under experiment.

THE Council of the Society of Arts have passed a resolution to the effect that it is desirable that the Cantor Lectures programme be from time to time, as far as may be found practicable, arranged to further the scheme of the Society's Technological Examinations, and that steps be taken for getting such lectures published in a special form as guide-books.

THE third number has been sent us of the *Journal* of the Society for the Promotion of Scientific Industry, whose headquarters is at Manchester. The *Journal*, which is of considerable size, contains reports of the meetings of the Society, at which a number of good practical papers have been read. One of the most scientifically important of these is on "The Chemistry of Calico Printing and Dyeing," by Mr. Charles Dreyfus.

WE have received from the author, M. E. Mailly, a very interesting "Essai sur la Vie et les Ouvrages de M. L. A. J. Quetelet," poet, *littérateur*, geometer, physicist, astronomer, and statistician, doubtless one of the most remarkable men Belgium has produced. As we gave some account of M. Quetelet's life and work shortly after his death, we need not further notice M. Mailly's book, which we recommend to all who desire to know further about this notable man. The publisher is Hayez, of Brussels.

WE are glad to see that Mr. J. E. Taylor's lectures in Ipswich on "Plants, their Structure, and their Uses," have been so successful that it has been found necessary to engage a larger hall than that in which the course was begun.

THE *Bulletin* of the Minnesota Academy of Natural Sciences for 1874 contains a report on the birds and a list of the mammals of Minnesota. There are also geological notes from early explorers in the Minnesota Valley, arranged by Mr. N. H. Winchell.

"THE Safe Use of Steam, containing Rules for the Guidance of unprofessional Steam Users," by an Engineer, seems a book likely to be of practical use to many persons. It is published by Lockwood and Co.

MR. L. SCHWENDLER sends us two papers by him: "On Earth Currents," reprinted from the *Proceedings* of the Asiatic Society of Bengal; and "On the General Theory of Duplex Telegraphy," from the *Journal* of the same Society.

"NOTES on a Till or Boulder Clay with Broken Shells, in the lower valley of the River Endrick, near Loch Lomond, and its relation to certain other Glacial Deposits," is the title of a paper by Mr. R. L. Jack, F.G.S., reprinted from the *Transactions* of the Geological Society of Glasgow.

UNDER the title of "Report of the Government Botanist for the year ending June 30, 1874," Baron von Mueller, of Melbourne, has given a *résumé* of the scientific work of the year, carried on by him or under his immediate supervision. In the first place, Baron Mueller refers to the issue during the year of the sixth volume of the "Flora Australiensis," in the production of which he is associated with Mr. Bentham; towards the composition of the seventh volume he mentions that it will include the Grasses, numbering about 250 species, the Rushes, Sedges, Restiaceæ numbering alone about 70 species, the Naiadeæ, Palmaceæ, &c. With regard to the number of species, however, these may be considerably modified before publication. In reference to a botanical appendix which Baron Mueller made to the works of Mr. F. A. Campbell, of Geelong, on the New Hebrides and the Loyalty Islands, which appendix was drawn up from collections made by the author during a visit to these islands, he says: "By such means we have obtained the first connected records of the insular vegetation of those spots of the globe after the lapse of more than a century since their discovery. Such opportunities for research should also be seized on by other travellers, and especially by educated settlers residing on these islands, as thereby will be gained not merely an advancement for phytographic science, but also a closer acquaintance with the natural productions of any of the Pacific insular lands, to the advantage also of Australian industries and commerce." With regard to the Palæontology of Victoria, Baron Mueller describes the vegetation of the Pliocene period as remarkable for its densely umbrageous trees of almost tropical types, which, as very recently ascertained, spread over very extensive areas, where in the present nothing of the past physiognomic grandeur of the vegetation is left. The elucidation of new economic plants and the tests as to their value in the world of commerce has long been one of Baron Mueller's special points. His pen has produced many pamphlets on these and kindred subjects, and from his laboratory have issued many actual results of his researches in this direction. The large collection of chemical products from the various species of Eucalyptus, Melaleuca, Acacia, &c., together with other vegetable products of Victoria, will be remembered by many as forming one of the principal features of the Australian Court of the London International Exhibition of 1873. This collection, which included oils, tars, acetic acids, and alcohol from species of Eucalyptus, Melaleuca, Casuarina, &c., as well as fibres, papers, and starches, were, at the close of the Exhibition, presented to the Kew Museum, where they are now exhibited. In regard to what Baron Mueller terms "field service," he says he was engaged for seven days in December 1873 in investigating the plants in the forest regions of the Upper Yarra and the southern branches of the Goulburn River. Measurements were also taken at this time of the heights of some lofty trees of *Eucalyptus amygdalina*, the highest of which gave 400 ft. To some trees which appeared to be higher access could not be obtained in the short time allowed and the means at command, as the dense jungle would have to be cleared for a base line. A magnificent species of *Festuca* (*F. dives*), discovered in West Gippsland by Baron Mueller in 1860, "was now," he says, "ascertained to have a wide range through the forests

towards the Yarra and Goulburn sources, where among grasses it forms a most stately object, the height of 12 ft. being not unusual, while occasionally this superb grass, in the fern-tree gullies or rivulets, attains, in rich soil, to 17 ft. The result of this journey," Baron Mueller says, "was the discovery of many plants new to Victoria and a few new to science. So far as the country itself is concerned, the Alps are easily accessible for horses from the eastern side, as the slopes are more gradual. The summits can be traversed for many miles with little or no impediment: being at an elevation of from 6,000 to 7,000 ft., they are above the region of trees and shrubs, and are consequently open in all directions."

WE have received the indexes to vol. vii. of "Patents and Patentees," 1872, for the colony of Victoria. The volume contains three separate indexes: "Subject Matter," "Alphabetical Index of Names," "Chronological and Descriptive," and seventeen sheets of illustrations. The work gives in a compact form a good idea of the activity of inventors in the colony.

THE additions to the Zoological Society's Gardens during the past week include a Black-handed Spider Monkey (*Ateles melanochir*) from Central America, presented by Mr. H. Campbell; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. C. Lucas; a Ring-necked Parrakeet (*Palaornis torquata*), from India, presented by Miss Attwood; a Yellow-bellied Parrakeet (*Platyercus flaviiventris*) from Tasmania; and a Little Grebe (*Podiceps minor*), British, purchased.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for this month contains several articles and notices of interest, the most important of which are: "Observations on the Anatomy of *Tenia mediocanellata*," by Mr. F. H. Welch, in which the author describes the detailed structure of that species, which, as he remarks, is considerably more common than the better known *T. solium*. Two plates accompany the description; very instructive sections through the segments in different directions occupying one of them.—Mr. C. H. Golding Bird describes the method to be employed in imbedding in elder-pith for cutting sections, a method more simple and frequently as advantageous as imbedding in wax, the moistened pith adapting itself to the inequalities and supporting the substance to be cut, in a most convenient manner, without the necessity for a tripod, spirit-lamp, &c., required when wax is used.—Mr. W. Archer has a paper "On Apothecia occurring in some Scytonematous and Sirospionaceous Algæ, in addition to those previously known," in which the transfer by Bornet of *Ephēbe pubescens* to the lichens suggested observations as to whether other species, *Stigonema* and allied genera, would not require similar relegation on account of the discovery of apothecia and spermogonia in them. The question as to the nature of these Gonidia-forming Algae types is discussed.—Mr. Ray Lankester makes "Observations on the Development of the Cephalopoda," in which he continues his elaborate investigations on the development of the Mollusca. The points on which most stress is laid in the present paper are the formation of the blastoderm and the nature of the "autoplasts;" the development of the pen-sac, and of the alimentary canal, and especially of the eye, whose radical similarity in the di- and tetra-branchiate Cephalopoda is proved, at the same time that its great difference from the vertebrate organ is rendered equally apparent.—Mr. H. C. Sorby has a paper "On the Chromatological Relations of *Spongilla fluviatilis*," which is shown to contain much the same colouring matter, soluble in carbon-disulphide, as the highest plants, though in different proportions.—The last paper, reprinted from this journal, is Prof. Huxley's "Classification of the Animal Kingdom," read before the Linnean Society in December last.—A review is given of Stricker's "Manual of Histology," as well as an excellent short life, by Dr. Payne, of Dr. Lankester, one of the founders of the journal.

Astronomische Nachrichten, No. 2,016.—In this number is a list of some thirty stars, of types iii. and iv., discovered by D'Arrest. Notes on colour and bands in the spectrum of each